Energy Storage in The Ireland

Guidelines to do business in the e-storage sector

Interreg
EUROPEAN UNION
North-West Europe
STEPS
European Regional Development Fund

E-Storage in the Ireland

- Energy Market design
- Permitting and Standardisation (EU)
- Health & Safety, Environmental
- Business Support
- Best Practices
- Financial Supports (Ireland and EU)

Energy Market Design

Market designs, energy prices & capacity mechanisms

Interreg North-West Europe STEPS

ISEM

The Integrated Single Electricity Market (I-SEM) is a wholesale electricity market arrangement for Ireland and Northern Ireland. The market arrangements are designed to integrate the all-island electricity market with European electricity markets, making optimal use of cross-border transmission assets. In addition to integration with Europe, some of the key considerations in the design of the I-SEM include how energy is bought and sold; how generators are remunerated for availability; forward trading arrangements and market liquidity; market power controls; and the systems, policies and procedures that are required to operate the market. The market arrangements present participants with many new challenges, but they also offers participants many new opportunities. Broadly, the I-SEM arrangements are intended to:

- enable broad participation in energy markets,
- increase the opportunities for participants to trade in different time frames,
- provide participants with a variety of arbitrage and hedging opportunities,
- maximise the efficient use of interconnectors in system balancing,
- provide cost drivers for system balancing, and
- integrate balancing and system security actions with market operation

Source: https://www.eirgridgroup.com/__uuid/1458bec2-f1e3-493c-92de-8dd2228bca1c/EirGrid-Group-I-SEM-QuickGuide.pdf

TSO & DSO Ecosystem

There are multiple critical stakeholders in the All-Island electricity sector including:

- the TSOs, EirGrid and SONI;
- the TAOs, namely ESB Networks and NIE Networks
- the regulatory authorities (RAs), with CRU in Ireland, the Northern Ireland Authority For Utility Regulation (NIAUR),
- and SEM Committee (SEMC); and – the Ireland and Northern Ireland governments.

The SEM Committee is the governing body for the I-SEM. It oversees the design and implementation of the I-SEM and makes decisions on licenses and market codes relevant to the implementation of the I-SEM. The mission of the SEM Committee is to protect the interests of consumers of electricity by promoting effective competition in the sale and purchase of electricity through the I-SEM.

The Regulatory Authorities—the Commission for Energy Regulation (CER) in Ireland and the Utility Regulator (UR) in Northern Ireland—are responsible for administration of the market codes; licensing of market operators and participants; and monitoring the operation of the I-SEM and the conduct of its participants.

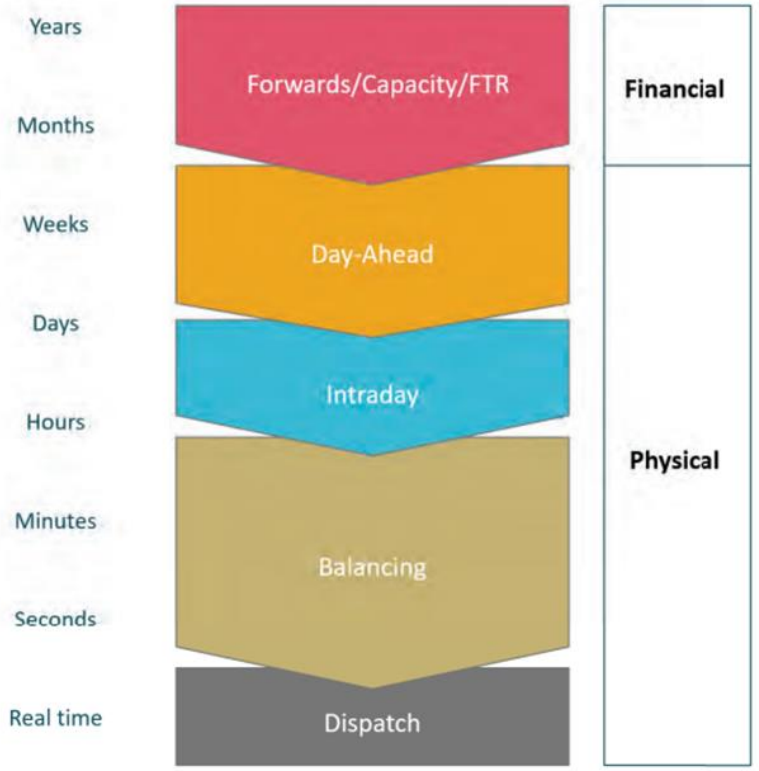
The Transmission System Operator (TSO) in Ireland is EirGrid and SONI is the TSO for Northern Ireland. Responsibilities for market operations, settlement and credit risk management are split between the TSOs, SEMO (a joint venture between EirGrid and SONI), and the (European) Joint Allocation Office (JAO).

EirGrid and SONI are also the Nominated Electricity Market Operators (NEMOs) for their geographic regions2 in the (coupled) ex ante markets. The NEMOs interact with the (European) Market Coupling Operator (MCO), who is responsible for running the market coupling process.

The existence of a single market operating in two countries alongside the consequent doubling of the number of critical stakeholders creates significant coordination and execution challenges with respect to all aspects of market design, and particularly support mechanisms for capital assets in the power sector.

Energy Market

The I-SEM comprises two ex ante[3] energy markets, a balancing market, two markets for financial instruments, and a market for capacity remuneration. These markets operate independently and on different timelines.



Source: https://www.iesa.ie/_files/ugd/9123eb_a4d45cbfdbcd4efb82831368806b666f.pdf

Drivers of Net Welfare benefits

- There are two fundamental drivers of the value of energy storage:
- energy storage makes better use of the renewables fleet; and
- it reduces the need for carbon-emitting conventional peaking capacity.

These two fundamental benefits manifest themselves in several ways in our simulations, including:

- reduced dispatch down which improves the capacity factor of renewables generation leading to lower costs;
- a smaller conventional peaking fleet which results in a lower emissions source of back-up power; and
- lower production costs and carbon emissions resulting from the displacement of thermal generation.

Benefits of Irish Market

- By participating in the Irish day-ahead energy market, energy storage can reduce day-a-head carbon emissions by 50% by using long-duration storage technologies. This makes a material contribution to meeting ambitious 2030 power sector decarbonisation goals.
- Strategic deployment of energy storage in transmission constrained regions of the network reduces the dispatch-down of renewable generation from constraints without the need for network reinforcement, unlocking additional carbon savings.
- By contributing to security of supply, helping to support renewable capacity, and displacing fossil fuels in the balancing market, energy storage can deliver a net saving to end consumers in Ireland of up to €85m per year.
- These benefits are additional to the carbon, renewable curtailment, and end consumer savings offered by energy storage through the provision of zero-carbon system services.
- Energy storage helps the integration of renewables at all stages by ensuring that generation is not wasted; reducing oversupply by up to 60%, constraint volumes by up to 90%, and curtailment by 100%.

Barriers to storage roll out in Ireland

The fundamental barrier to future development of energy storage in the SEM is the potential lack of a viable business model resulting from the benefits of storage not being appropriately valued.

There are multiple reasons why this could be the case, ranging from markets that were designed for conventional and / or renewable generation to regulatory instability, and so on. IESA analysis suggests there are several specific barriers that could impede the development of storage (and particularly longer-duration storage) in the SEM, including:

- uncertainty over the regulatory framework for System Services beyond April 2024, which increases investment risks
- the lack of a level playing field in existing support mechanisms (specifically RESS and the CRM) for storage, which results in the benefits of storage not being appropriately valued
- a grid connection policy that implicitly disadvantages energy storage projects
- a transmission network charging design that does not incentivise flexibility
- policy emphasis focusing on short-duration storage rather than long duration storage, which might suggest that not much more is required of energy storage in the SEM and
- a complex web of critical stakeholders that complicate decision making, which can slow progress on a range of critical actions.

Source: https://www.energystorageireland.com/wp-content/uploads/2022/05/GameChanger-ESI-Report-May2022-Web-1.pdf

Permitting and Standardisation

Rules and regulations in the e-storage sector

Interreg North-West Europe STEPS

European Regulations

- **EU Batteries Directive:** Energy storage solutions must comply with the European Batteries Directive, which:

1. Prohibits the placing on the market of certain batteries manufactured with mercury or cadmium.
2. Encourages the recycling of (parts of) batteries.
3. Supports the improvement of batteries and environmental performance of all actors involved in the life cycle of batteries and accumulators.

- Currently, the EU is working on a proposal for a regulation concerning batteries and waste batteries, which would replace the Batteries Directive (2006). This ‘new’ regulation would govern the entire battery lifecycle.
- It would establish mandatory requirements for sustainability (such as carbon footprint rules, minimum recycled content, performance and durability criteria), safety and labelling for the marketing and putting into service of batteries, and requirements for end-of-life management. It would also introduce due diligence obligations for economic operators sourcing raw materials.

Health & Safety, Environmental Regulations

Rules and regulations in the e-storage sector

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Environmental Regulations

Guidance is provided on the EPA Website (https://www.epa.ie/our-services/compliance--enforcement/waste/batteries/)

Summary points:

1. Most SMEs will be considered as Battery Producers as most import into Ireland for placement on the market here.
2. There are two routes you can follow for meeting obligations (see next slide)
3. When you are a battery producer in another state, you need to follow that state's obligations
4. The legislation in place in Ireland is the European Union (Waste Batteries and Accumulators) Regulations 2014 (ref. https://www.irishstatutebook.ie/eli/2014/si/283/made/en/print)
5. SMEs should register as a producer at https://www.producerregister.ie
6. Use the WEEE Blackbox https://www.prlblackbox.ie/login.aspx every month to declare the types and quantities of batteries placed on the market
7. You need to factor in the cost of environmentally sound waste practices and legal management of your batteries when they become waste.
8. Ensure the labelling is correct (e.g. if they are categorised as hazardous substances, they need labelling as such).

Environmental Regulations

The guidance provides 2 methods of financing environmentally sound management of waste batteries:

1. Join a compliance scheme such as WEEE Ireland or European Recycling Platform (ERP) Ireland. Ref. https://www.weeeireland.ie and https://erp-recycling.org/ie/ for multinational compliance.
2. Self comply (ref. Section 4.3.2 of the document at https://www.epa.ie/publications/compliance--enforcement/waste/guidance-for-battery-producers.php). Self-complying battery producers must submit the following information to the EPA:
   a) Waste Battery Management Plan (WBMP) – a report that looks forward over a three-year period, so submit one every three years. It informs the EPA how you will manage your waste batteries and how you will finance this.
   b) Waste Battery Management Report (annual)

   There are fees for the EPA to review the two periodic documents required to self-comply.

You can only join a Compliance Scheme or Self Comply (not both).

Compliance Scheme Method

1. By Joining to a compliance scheme the batteries producers exclude the administrative burden and cost of compliance.
2. There are two compliance schemes available in Ireland. the WWEE Ireland or European Recycling Platform (ERP) that provide a compliance service to their battery producer members meeting the producer obligations under a service fee.
3. Producers who join a compliance scheme are exempt from certain obligations under the Batteries Regulations, including:
   - Organisation of transport and management of waste batteries.
   - Meeting collection, recovery, and recycling targets.
   - Record keeping.
   - Reporting quantities of waste batteries to the EPA

Self-Complying

1. Battery producers choosing a Self-comply system must arrange for the collection, movement, and treatment of their waste batteries themselves, and submit the Waste Battery Management Plan (WBMP) and the Waste Battery Management Report (WBMR) to the EPA to know how the battery producers are meeting their legal obligations.
2. The Waste Battery Management Plan (WBMP) informs the EPA how you will manage your waste batteries and how you will finance this. The plan Report looks forward over a three-year period, therefore must be submitted one every three years along with an administration fee. The waste battery management plan template can be found online at the EPA website.
3. The Waste Battery Management Report (WBMR) contains detailed information on the quantities of batteries that you, as a battery producer, managed during the previous calendar year and it must be submitted by 31 January every year. This report must also describe how these waste batteries were recycled. As the previous document this template can also be found at the EPA website.
4. Self-complying battery producers must display a statutory notice at, or within one metre of each, entrance to their premises.

Other considerations

EMS / BMS:

1. You should use safe and standard compliant components
2. The BMS should ensure that the battery is not pushed beyond its limits.
3. The BMS must be certified according to IEC61508 (the standard for functional safety of electrical/electronic/programmable electronic safety-related systems).
4. The EMS saves large amounts of BMS data locally and to a secure cloud system. This can be used for analytic purposes to detect possible battery misbehaviour or deviations at an early stage.

Decommissioning:

The decommissioning process must take into consideration the full discharge of all power prior to being considered hazardous waste. If the batteries are not discharged, there is always a risk of the anode and cathode short-circuiting.

Safe Shutdown:

Battery systems must shut down immediately for a controlled shutdown if a safety issue or battery anomaly is detected by the EMS, the BMS or any other safety device. It is also important to have a manual E-stop ‘emergency stop’ that can be performed by operators or first responders.
The E-stop should be accessible (this can be an issue for vertically stacked systems).

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Scope of Regulations:

(1) These Regulations, save where the context otherwise requires, shall apply—

(a) to all types of batteries, regardless of their shape, volume, weight, material composition or use, and

(b) without prejudice to European Parliament and Council Directives—

(i)2000/53/EC of 18 September 2000 on End-of-Life Vehicles10, and

(ii)2002/96/EC11 of 27 January 2003 on Waste Electrical and Electronic Equipment.

(2) Without prejudice to sub-regulation (1), these Regulations shall not apply to batteries used in equipment—

(a) connected with the protection of Member States' essential security interests, arms, munitions, and war material, with the exclusion of products that are not intended for specifically military purposes or, as appropriate,

(b) designed to be sent into space.

Prohibition of specified hazardous substances and inappropriately labelled batteries

Scope of Regulations (continued):

Subject to regulation 6, on and from—

(a) 26 September 2008, any person shall be prohibited from placing on the market or, as appropriate, distributors shall be prohibited from distributing—

(i) all batteries that contain more than 0.0005% of mercury by weight,

(ii) portable batteries that contain more than 0.002% of cadmium by weight or, as appropriate,

(iii) any battery or, as appropriate, battery pack—

(A) that is not marked in accordance with the provisions of regulations: "*Obligation of producers to provide information to users of batteries"* and "*Obligation of producers to provide information to the Registration Body"* or, as appropriate,

(B) whose size is such that the symbol for the marking of batteries indicating separate collection would be smaller than 0.5 X 0.5 cm and whose packaging is not marked in accordance with the provisions of the regulations mentioned above,

and

(b) any person who places on the market or, as appropriate, distributes any battery or battery pack in contravention of this regulation shall be obliged to immediately withdraw such battery or battery pack from the market, and

(c) 26 September 2009, any person shall be prohibited from placing on the market or, as appropriate, distributors shall be prohibited from distributing any battery placed on the market on or from 26 September 2009 that does not display the capacity of the battery concerned in accordance with the provisions of regulation *Obligation of producers to provide information to users of batteries* unless exempted.

Exemptions:

(1) The prohibition in—

(a) regulation 5(a)(i) shall not apply to button cells with a mercury content of no more than 2% by weight,

(b)5(a)(ii) shall not apply to portable batteries intended for use in—

(A) emergency and alarm systems, including emergency lighting,

(B) medical equipment, or

(C) cordless power tools.

(2) The provisions of this Part shall not apply to batteries placed on the market prior to 26 September 2008 in compliance with Council Directive 91/157/EEC12 of 18 March 1991 on batteries and accumulators containing certain dangerous substances.

Regulations:

Recycling of waste batteries

(1) On and from 26 September 2011, each—

(a) producer that is responsible for financing the environmentally sound management of any waste battery in accordance with the regulations of provisions,

(b) end-user of an industrial or as appropriate, automotive battery, other than an automotive battery from a private or, as appropriate, non-commercial vehicle avails of alternative financing methods,

(c) authorised waste collector, acting independently of any obligated producer or approved body established in accordance with the provisions of Part V of these Regulations, engaged in the collection and transport of any waste industrial battery or, as appropriate,

(d) person who becomes obligated in accordance with the regulations of provisions shall ensure that recycling processes, as a minimum, meet the recycling efficiencies set out in Part B of Annex III of the Directive, subject to any amendment that may be made to that Annex from time to time.

(2) On and from 26 September 2008, the operator of each facility in the State engaged in the recycling of waste batteries shall be required to consider the—

(a) introduction of certified environmental management schemes in accordance with Regulation (EC) No. 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community ecomanagement and audit scheme (EMAS)16 ,

(b) development of new recycling and treatment technologies, and

(c) promotion of research into environmentally friendly and cost effective recycling methods for all types of batteries.

Regulations:

Recycling of waste batteries (continued)

(3) Notwithstanding sub-regulation (2), the Agency or, as appropriate, a local authority, shall encourage an applicant seeking a facility permit or a facility licence or the renewal of a permit or a licence, to operate a facility for the recycling of waste batteries —

(a) introduction of certified environmental management schemes in accordance with Regulation (EC) No. 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community ecomanagement and audit scheme (EMAS),

(b) development of new recycling and treatment technologies, and

(c) promotion of research into environmentally friendly and cost effective recycling methods for all types of batteries before considering such an application.

(4) Without prejudice to sub-regulation (2) the Minister from time to time may issue guidance concerning new recycling technologies.

Regulations:

Disposal of waste batteries:
(1) On and from 26 September 2008, any person shall be prohibited from disposing waste industrial and automotive batteries in landfill or by incineration.

(2) The residues of any battery may be disposed of in landfill or by incineration provided it has already undergone both treatment and recycling in accordance with the regulations of provisions.

Regulations:

Treatment of waste batteries:

(1) On and from 26 September 2009, each—

(a) producer that is responsible for financing the environmentally sound management of any waste battery in accordance with the regulation of provisions,

(b) end-user of an industrial or as appropriate, automotive battery, other than an automotive battery from a private or, as appropriate, non-commercial vehicle who avails of alternative financing methods,

(c) authorised waste collector, acting independently of any obligated producer or approved body established in accordance with the provisions of Part V of these Regulations, engaged in the collection and transport of any waste battery or, as appropriate,

(d) person who becomes obligated in accordance with the regulations of provisions shall ensure that waste batteries are treated and recycled using best available techniques in terms of the protection of health and the environment, shall ensure such treatment and recycling meets the requirements set out in Part A of Annex III of the Directive, subject to any amendment that may be made to that Annex from time to time and, as a minimum, shall ensure such treatment and recycling complies with Community legislation as regards health, safety and waste management, and shall regularly evaluate and adapt best available techniques in relation to recycling efficiencies.

Regulations:

Treatment of waste batteries (continued):

(2) Without prejudice to sub-regulation (1), on and from 26 September 2008, where any waste battery is to be treated in another member state or a third country, the—

(a) producer that is responsible for financing the environmentally sound management of any waste battery in accordance with the regulations of provisions,
(b) end-user of an industrial or as appropriate, automotive battery, other than an automotive battery from a private or, as appropriate, non-commercial vehicle avails of alternative financing methods,
(c) authorised waste collector, acting independently of any obligated producer or approved body established in accordance with the provisions of Part V of these Regulations, engaged in the collection and transport of any waste industrial battery or, as appropriate,
(d) person who becomes obligated in accordance with the regulations of provisions, shall ensure it is transported in accordance with the provisions of Council Regulation (EC) No. 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste Council Regulation (EC) No. 1420/1999 of 29 April 1999 establishing common rules and procedures to apply to shipments to certain non-OECD countries of certain types of waste and Commission Regulation (EC) No. 1418/2007 of 29 November 2007 concerning the export for recovery of certain waste listed in Annex III or IIIA to Regulation (EC) No. 1013/2006 of the European Parliament and of the Council to certain countries to which the OECD Decision on the control of transboundary movements of wastes does not apply , shall ensure it is treated and recycled at a facility appropriately authorised by the relevant competent authority or authorities in the member state or third country concerned and, when treated and recycled, shall furnish documentary evidence that the requirements of sub-regulation (1) have been complied with.

Regulations:

Treatment of waste batteries (continued):

(3) Without prejudice to sub-regulation (1), on and from 26 September 2008, any holder of, as the case may be, a waste facility permit, a registration certificate or waste collection permit shall furnish to the Agency such information in relation to waste batteries collected, accepted, sorted, transferred, recycled, disposed of, brokered, or otherwise managed or treated within a specified period, in such form and at such frequency as may be specified by the Agency.

(4) Without prejudice to sub-regulation (2), on and from 26 September 2008, any person exporting waste batteries to any third country, shall—

(a) ensure that they are treated in accordance with Article 15 of the Directive and any detailed rules for the implementation of Article 15 as laid down in accordance with the procedure referred to in Article 24(2) of the Directive, and

(b) demonstrate to the satisfaction of the Agency that all the waste batteries concerned were—

(i) treated at an appropriate facility in accordance with the requirements of sub-regulation (1), and

(ii) recycled at an appropriate facility in accordance with the requirements of regulation 28(1),

before claiming fulfilment of the obligations and efficiencies laid down in Annex III of the Directive, subject to any amendment that may be made to that Annex from time to time.

(5) Without prejudice to sub-regulations (1) and (2), on and from 26 September 2008, any battery that is collected with waste electrical and electronic equipment in accordance with national waste electrical and electronic equipment Regulations, shall be removed from the waste electrical and electronic equipment concerned prior to its environmentally sound management in accordance with the provisions of these Regulations.

Fire Safety

Rules and regulations in the e-storage sector

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Overview

Resources:

EPRI research identified four root causes of thermal runaway: internal cell defects; faulty battery management systems, including bad hardware or software; insufficient electrical isolation; and environmental contamination from things like humidity and dust.

The HSA website contains two links on fire and law. It does not specifically address energy storage but provides strong guidance on all aspects of fire safety.

Energy Storage Ireland have provided an information paper on Safety of Grid-Scale Battery Energy Storage Systems on their website which this training document draws substantially upon.

Greensolver.net contains a useful blog post on Five Key Safety Considerations for Battery Energy Storage Systems Safety (including the functional safety of Software in Electrical/Electronic Systems (BMS), a description of typical causes of fires, Ergonomics and E-Stops and Cybersecurity).

Fire Risk

Source https://www.energystorageireland.com

- In the absence of the proper prevention and protection measures outlined below a *battery cell can become overheated*.
- This can happen for reasons that could be:
- **mechanical** (such as impact or vibration),
- **thermal** (such as exposure to high heat or inadequate ventilation) **and**
- **electrical** (where the battery cell is overcharged due to improper management).
- Potentially leading to a 'cell failure'.
- If temperature increases at a faster rate than it can be dissipated then this can cause the cell to start to break down, which causes a reaction due to the chemical components of the batteries, that leads to self-heating - **thermal runaway**. If no action is taken to prevent this, it can lead to a **fire** and the **release of toxic or flammable gases such as carbon dioxide or hydrogen fluoride inside the container**.
- When multiple cells are present there is a risk that an individual overheating cell or cell fire can start to impact its neighbours leading to a cascade effect as more and more cells overheat.
- The design of battery storage systems is extremely important in this regard as the goal is to prevent a single cell failure from spreading to others and to contain and reduce the chances of thermal runaway occurring in multiple cells.

Safety Standards & Testing

Source https://www.energystorageireland.com

There are numerous international standards that ensure that safety is incorporated in the design, manufacture and transportation of batteries in order to minimise the occurrence of defects which could result in a potential hazard.

- **The International Electrotechnical Commission** (**IEC**), which develops international standards for all electrical, electronics and related technologies, including batteries, has a range of safety standards for testing and certification of lithium ion batteries and storage systems:
- • Battery cells certified to UL1642 and IEC62619 (Safety requirements for secondary lithium cells and batteries, for use in industrial applications);
- • IEC 62620 (Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for use in industrial applications); 12
- • IEC 63056 (Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries for use in electrical energy storage systems); • IEC 62933-5-2 (Safety requirements for secondary batteries and battery installations - Part 5: Safe operation of stationary lithium ion batteries)
- • IEC 62485-5 (Safety requirements for secondary batteries and battery installations - Part - 5: Lithium-ion batteries for stationary applications). Testing to these standards is conducted by the battery manufacturer.

International codes and standards are regularly updated using real-world experience and new testing to ensure safety standards are continuously evolving..

Safety Standards & Testing (continued)

Source https://www.energystorageireland.com

- Lithium based batteries are also subject to the United Nations Regulations on the Transport of Dangerous Goods (UN/DOT 38.3).
- These provide for the safe packaging and shipment of lithium-ion batteries and require a variety of testing under different altitude, vibration, impact and thermal conditions before transportation. Manufacturers of lithium batteries and products using lithium batteries must account for these testing requirements in the design, manufacture and distribution of their products.
- These standards and codes mean that developers can be sure that the batteries they are sourcing for their systems are certified to high safety standards with extremely minimal chance of defects occurring.
- The installation of the battery storage system at the site is finalised via **site acceptance testing**.
- The purpose of this testing is to ensure that the system is installed properly, that no defects have occurred in transport and that the battery management and protection systems are working properly. This testing is carried out in cooperation between the battery system operator and the supplier.
- At a system level, UL9540A8 is a test method for evaluating thermal runaway in battery storage systems that reduces the risk of a single cell event spreading to the rest of the system. This is a global standard that storage system suppliers test their products under to demonstrate compliance.

Safety Standards & Testing (continued)

Source https://www.energystorageireland.com

- The international energy consultancy, DNV, has created global best practice guidelines for the safety, operation and performance of grid-connected energy storage systems.
- These guidelines are intended to help battery storage system developers and were created by drawing on international expertise from numerous industry bodies, associations, universities and technical experts. They contain a wide ranging set of recommendations in areas such as storage system design and safety, risk management, testing and coordination with local authorities.
- In July 2020, DNV also published a detailed technical report titled 'McMicken Battery Energy Storage System Event Technical Analysis and Recommendations' which contains important information and recommendations on system design and incident prevention using the latest industry experience.
- https://www.ul.com/offerings/ul-9540a-test-method 9 DNV GL best practice guidelines for energy storage systems: https://rules.dnvgl.com/docs/pdf/DNVGL/RP/2017-09/DNVGL-RP-0043.pdf 10 https://www.aps.com/-/media/APS/APSCOM-PDFs/About/Our_Company/Newsroom/McMickenFinalTechnicalReport.ashx?la=en&hash=50335FB5098D9858BFD276C40FA54F CE 13 5.3 System Design Battery energy storage systems are designed to prevent a problem in one battery cell from spreading to others in the system.

Cell separation

Source https://www.energystorageireland.com

- **Cells can be separated from each other using air gaps or thermal barriers between cells composed of heat resistant materials.**
- These techniques help to dissipate heat in the event of a cell failure, and subsequent overheating, and prevent adjacent cells or modules from being affected. This is one of the most important design considerations in a storage system that greatly reduces the risk of a thermal runaway event occurring.

The image shown shows what the inside of a storage container can look like. It is possible to see the separate racks and modules of battery cells.

Cell separation (continued)

Source https://www.energystorageireland.com

- This also makes it easier to contain problems if they do arise in one part of the system.
- To provide an additional layer of protection, batteries for energy storage systems are also generally housed in separate containers.
- This reduces the risk of a problem in one container spreading to the rest of the facility.
- This design layout ensures the batteries are held securely within the containers which provides protection from external elements that might cause mechanical damage such as impacts or vibration. It is important that batteries are kept at a stable operating temperature to ensure they are operating within their design limits.
- This also improves the performance and operating life of the battery.
- Energy storage systems contain cooling and ventilation systems. These maintain the batteries at a stable operating temperature and remove excess heat if there is a risk of overheating. For example, these systems may use ventilation, air conditioning or liquid cooling to help keep batteries at the right temperature.
- .

System Control

Source https://www.energystorageireland.com

- The safety systems for a battery storage project operate on multiple layers from the individual battery cell right up to the whole storage system and this is managed by the BMS. The role of the BMS is to continually monitor and manage:
- The charge level of each cell; it prevents voltage from going too high or too low. It also manages the charge levels among different cells and can redistribute flows ensuring the system is managed stably.
- State of health; it also works to identify problems before they occur. It allows the operators to know the state of health of the individual battery cells so that any deterioration or fault can be detected, and appropriate maintenance carried out.
- Temperature of the battery system components and can control supporting systems to regulate this.
- Providing real-time information at a cell, module, rack and system level to the EMS and storage system operators. 14 In this way, the BMS ensures that the batteries are continually monitored and protected to prevent problems and to ensure the batteries are ready to deliver power to the grid when needed.11 As soon as the BMS detects that a specific battery cell, or group of cells, is acting in a way that it should not it can instantly reduce the flow of electricity through the cell, switch it off or disconnect it completely from the power supply depending on the seriousness of the problem. This minimises the risk of a problem escalating in a cell or group of cells and spreading to others.

Mitigation

Source https://www.energystorageireland.com

- In the unlikely event that a problem occurs such as **thermal runaway** that could lead to a fire, energy storage systems have additional design measures such as smoke sensors and alarms to detect the issue and measures such as deflagration venting and fire suppression systems to contain and reduce it.
- These **suppression systems** use techniques such as inert gas, foam suppression, fire sprinklers or water mist etc. to control fires. In the first instance an inert gas or clean agent suppression system that either targets oxygen or cooling may be used to extinguish a single cell fire, or an electrical fire not related to the battery, to prevent it spreading to other modules. In the second instance a water-based suppression system may be used to cool the system completely and prevent escalation.
- These measures, or combination of measures, help ensure that the risk of fire or accumulation of toxic or flammable gases within the container is minimised.
- **Before constructing the project battery energy storage project developers should work with the Local Authority, first responders and fire services to ensure they understand the kinds of batteries and fire suppression technologies used in the storage facility and how best to work together to deal with any problem that might arise.**

Mitigation (continued)

Source https://www.energystorageireland.com

- This should involve incident pre-planning and the arranging of a site visit before the facility is operational. As battery fires can release flammable gases, it is important that first responders and fire services are aware of these risks and have plans in place on how to deal with any potential hazards. **Two resources to assist in this regard are as follows**:
- The Energy Institute, which is a chartered professional membership body for the global energy industry, has produced a guidance note for battery energy storage system fire planning and response.12 This document is intended to help developers to understand and plan for potential risks and provides guidance to first responders on how to respond to BESS fires.
- The European Advanced Rechargeable and Lithium Batteries Association (RECHARGE)13 provides technical and legislative expertise on lithium batteries and works to ensure best practices and standards for the use of this technology.
- They carry out work on lithium-ion battery safety and have published a rescue and training manual for first responders and fire services regarding lithium batteries in storage facilities. Ref.
    - https://www.mpoweruk.com/bms.htm https://publishing.energyinst.org/__data/assets/pdf_file/0005/702095/Battery-Storage-Guidance-Note_2jk.pdf
    - https://www.rechargebatteries.org/
    - https://www.rechargebatteries.org/wp-content/uploads/2015/01/RESCUE-AND-TRAINING-MANUAL_LITHIUM-BATTERY-IN-STORAGE-2014-12-05.pdf
- It must also be noted that grid-scale energy storage systems must apply for planning permission and meet the relevant Local Authority or An Bord Pleanála planning requirements, including any appropriate fire safety assessments.

Resources

- https://eprijournal.com/a-focus-on-battery-energy-storage-safety/
- https://www.hsa.ie/eng/topics/fire/#gui
- https://www.hsa.ie/eng/topics/fire/#law
- https://greensolver.net/5-key-safety-considerations-for-battery-energy-storage-systems/
- https://www.energystorageireland.com/wp-content/uploads/2021/08/ESI-Information-Paper-on-the-Safety-of-Grid-Scale-Battery-Energy-Storage-Systems-July-2021.pdf

Cyber Security

Cyber Security

Guidance from https://greensolver.net

- Computer security, **cybersecurity**, or information technology security (IT security) is the protection of computer systems and networks from information disclosure, theft of, or damage to their hardware, software, or electronic data, as well as from the disruption or misdirection of the services they provide.
- BESS developers should rely on experienced suppliers who can ensure the integrity of all equipment and routinely update security software.
- Only vetted, trained personnel should have access to the BESS. Likewise, connections between the BESS and other web-based systems should be kept at a minimum

Business Support

Policies and regulations regarding e-storage

Interreg North-West Europe STEPS

Policy instruments

Best Practices

Interreg
North-West Europe
STEPS

Profile of Ireland

- **Universities:** …
- **Universities of Applied Sciences:** …
- **ROC's (practical education):** …
- **Energy transition:** …

Knowledge institutions and students in Ireland

- A total of x universities including three Universities of Applied Sciences educate more than …. **(NUIG to assist)**

xx,000
University of Applied Sciences Students

xx,000
Research University Students

xx,000
Students in Vocational Education

Financial supports (Ireland & the EU)

Interreg North-West Europe STEPS

European battery storage funding

Battery storage, among other important key technologies and innovations, is one of the funding priorities within the European Union.

European funds are an important means to connect our energy transition ecosystem with other important hotspots in the EU, for example through cross-border cooperation and knowledge transfer.

Examples of European subsidies that SMEs and knowledge institutions in NWE are eligible for are:

- **M-ERA.NET:** Aims to strengthen the contribution of R&D in materials to energy-related applications.
- **Horizon Europe:** EU's key funding programme for research and innovation. It tackles climate change, helps to achieve the Sustainable Development Goals and boosts the EU's competitiveness and growth.

Irish funding programs

- **Capital tax allowances,**
- **Research, Development & Innovation (RD&I) Fund (**https://www.enterprise-ireland.com/en/funding-supports/company/esetablish-sme-funding/r-d-fund-large-projects-.html)
- **SEAI National Energy RD&D Funding (**https://www.seai.ie/grants/research-funding/research-development-and-demonstration-fund/ **)**

Irish Agency Supports

Bord Gais, Electric Ireland, Dept, SEAI, Enterprise boards...

Interreg
North-West Europe
STEPS
European Regional Development Fund

EUROPEAN UNION

THANK YOU!